REMARKS

Status of the Claims

Claims 1-21 and new claim 22 are pending, with claims 1, 20, 21, and 22 being independent. Without conceding the propriety of the rejections, claims 1-5, 12-14, and 16-21 have been amended to even more clearly recite and distinctly claim the presently claimed invention. New claim 22 has been added. Support for the amendments and new claim may be found in the original claims, as well as throughout the specification, including, for example, at page 7, 6th paragraph; page 8, 3rd paragraph; and page 14, 4th-6th paragraphs. Therefore, no new matter has been added.

Applicants respectfully request the Examiner to reconsider and withdraw the outstanding rejections in view of the foregoing amendments and the following remarks.

Claim Rejections under 35 U.S.C. § 103(a)

Claims 1 and 3-21 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Huss (U.S. Patent No. 4,935,577). Applicants respectfully disagree with this rejection; therefore, this rejection is traversed.

Huss relates to oligomerization utilizing catalytic distillation techniques. In particular the process of Huss is directed to an alpha-olefin which is oligomerized in the presence of a catalyst comprising boron trifluoride, a minute amount of water in a particular adsorbent material such as silica to a product predominating in those oligomer fractions having viscosities within the lubricating oil range such as the trimer and tetramer of 1-decene. (Col. 8, lines 36-42). Huss teaches that 1-olefins having from 3 to 20 carbon atoms and preferably 8 to 12 carbon atoms or various combinations of these alpha-olefins can be used. (Col. 8, lines 49-51). Huss teaches that in particular trimers and tetramers having viscosities in the lubricating oil range are formed.

In contrast, as recited in independent claim 1, the process of the presently claimed invention comprises inducing skeletal isomerization of an olefinic feedstock, with boiling points greater than 180°F, producing a skeletally isomerized olefinic feedstock. The skeletally isomerized olefinic feedstock is contacted with an

oligomerization catalyst in a catalytic distillation unit having, within it, at least one catalytic zone to produce a product with a higher number average molecular weight than the olefinic feedstock. The product is separated in the catalytic distillation unit into a light by-product fraction and a heavy product fraction, wherein the heavy product fraction comprises hydrocarbons in the lube base stock range. Claims 3 – 19 are dependent upon claim 1 and thus recite further limitations.

Skeletal isomerization of the olefinic feedstock assists in providing products with pour points in the desired range. Skeletal isomerization of the olefinic feedstock prior to oligomerization results in a higher yield of the lube base oil with a lower pour point. (page 14, 3rd and 4th paragraphs).

An olefinic feedstock with boiling points greater than 180°F approximately corresponds to a C_{7+} feedstock. The specification defines that a lube base oil has initial boiling points of at least 572°F (300°C) (approximately corresponding to C_{17}), and a typical lube base oil has an initial boiling point above 650°F (approximately corresponding to C_{20}). (Page 7, 6th paragraph and page 8, 3rd paragraph). Using the claimed olefinic feedstock, high quality lube oils are obtained by oligomerizing a minimum number of monomers. (page 8, 3rd paragraph). Applicants respectfully submit that since lube base stocks are C_{17+} to C_{20+} products, they can be produced from a C_{7+} feedstock in a single oligomerization step.

Accordingly, in the processes of the presently claimed invention, lube base stocks are being produced in a single oligomerization step from the claimed olefinic feedstocks (i.e., a feedstock with a boiling point of greater than 180°F). A single oligomerization produces high quality lubricant products and avoids excessive branching in the lube oil, which reduces the viscosity index. (page 8, 3rd paragraph).

It is respectfully submitted that the presently claimed process for making a lube base stock comprising inducing skeletal isomerization of an olefinic feedstock, with boiling point greater than 180°F, producing a skeletally isomerized olefinic feedstock, and contacting the skeletally isomerized olefinic feedstock with an oligomerization catalyst in a catalytic distillation unit is significantly different from the process of Huss. It is respectfully submitted that Huss does not disclose or suggest skeletal isomerization of the olefinic feedstock prior to oligomerization. In addition, as Huss discloses oligomerizing 1-olefins having from 3 to 20 carbon atoms,

Applicants respectfully submit that making lube base stocks from the olefinic feedstock of Huss requires multiple oligomerization steps. Huss discloses oligomerizing 1-olefins having from 3 to 20 carbon atoms providing trimers and tetramers having viscosities in the lubricating oil range. Accordingly, Applicants respectfully submit that lube base oil products of Huss may have reduced viscosity indexes due to excessive branching. Therefore, Applicants respectfully submit that Huss does not disclose or suggest the presently claimed primarily single oligomerization of a feedstock with a boiling point of greater than 180°F.

As recited in claim 20, the process of the presently claimed invention comprises obtaining a diolefin-containing olefinic feedstock with boiling points within the range of from 258° to 650°F and including between 10% and 50% olefins. Skeletal isomerization of the diolefin-containing olefinic feedstock is induced, producing a skeletally isomerized diolefin-containing olefinic feedstock. The skeletally isomerized diolefin-containing olefinic feedstock is selectively hydrogenated to saturate at least a portion of any diolefins present while not saturating most of the mono-olefins present, producing a selectively hydrogenated, skeletally isomerized diolefin-containing olefinic feedstock. The selectively hydrogenated skeletally isomerized diolefin-containing olefinic feedstock is contacted with an oligomerization catalyst in a catalytic distillation unit having, within it, at least one catalytic zone to produce a product having a number average molecular weight at least 20% higher than the olefinic feedstock. The product is separated in the catalytic distillation unit into a light by-product fraction and a heavy product fraction, wherein the heavy product fraction comprises hydrocarbons in the lube base stock range with a viscosity of greater than 2 cSt at 100°C, a viscosity index of above 80 and a pour point of less than -10°C. Nonolefinic portions of feedstock are withdrawn from the catalytic zone. The heavy product fraction is hydrofinished.

As explained above, skeletal isomerization of the olefinic feedstock assists in providing products with pour points in the desired range. Skeletal isomerization of the olefinic feedstock prior to oligomerization results in a higher yield of the lube base oil with a lower pour point. (page 14, 3rd and 4th paragraphs).

An olefinic feedstock with boiling points in the range of 258°F to 650°F approximately corresponds to a C_8 to C_{20} feedstock. The specification defines that a lube base oil has initial boiling points of at least 572°F (300°C) (approximately corresponding to C_{17}), and a typical lube base oil has an initial boiling point above 650°F (approximately corresponding to C_{20}). (Page 7, 6th paragraph and page 8, 3rd paragraph). Using the claimed olefinic feedstock, high quality lube oils are obtained by oligomerizing a minimum number of monomers. (page 8, 3rd paragraph). Applicants respectfully submit that since lube base stocks are C_{17+} to C_{20+} products, they can be produced from a C_{8+} feedstock in a single oligomerization step.

Accordingly, in the processes of the presently claimed invention, lube base stocks are being produced in a single oligomerization step from the claimed olefinic feedstocks (i.e., a feedstock with boiling points in the range of 258°F to 650°F). A single oligomerization produces high quality lubricant products and avoids excessive branching in the lube oil, which reduces the viscosity index. (page 8, 3rd paragraph).

It is respectfully submitted that the presently claimed process for making a lube base stock comprising inducing skeletal isomerization of a diolefinic-containing olefinic feedstock, with boiling points in the range of 258°F to 650°F, producing a skeletally isomerized, diolefin-containing olefinic feedstock, and contacting the skeletally isomerized, diolefin-containing olefinic feedstock with an oligomerization catalyst in a catalytic distillation unit is significantly different from the process of Huss.

It is respectfully submitted that Huss does not disclose or suggest skeletal isomerization of the olefinic feedstock prior to oligomerization. In addition, as Huss discloses oligomerizing 1-olefins having from 3 to 20 carbon atoms, Applicants respectfully submit that making lube base stocks from the olefinic feedstock of Huss requires multiple oligomerization steps. Huss discloses oligomerizing 1-olefins having from 3 to 20 carbon atoms providing trimers and tetramers having viscosities in the lubricating oil range. Accordingly, Applicants respectfully submit that lube base oil products of Huss may have reduced viscosity indexes due to excessive branching. Therefore, Applicants respectfully submit that Huss does not disclose or suggest the presently claimed primarily single oligomerization of a feedstock with boiling points in the range of 258°F to 650°F.

As recited in claim 21, a hydrocarbon in the lube base oil range is produced by a process comprising inducing skeletal isomerization of an olefinic feedstock, with boiling points greater than 180°F, producing a skeletally isomerized olefinic feedstock. The skeletally isomerized olefinic feedstock is contacted with an oligomerization catalyst in a catalytic distillation unit to produce a product having a higher number average molecular weight than the olefinic feedstock. The product is separated in the catalytic distillation unit into a light by-product fraction and a heavy product fraction, wherein the heavy product fraction comprises hydrocarbons in the lube base stock range.

As explained above, skeletal isomerization of the olefinic feedstock assists in providing products with pour points in the desired range. Skeletal isomerization of the olefinic feedstock prior to oligomerization results in a higher yield of the lube base oil with a lower pour point. (page 14, 3rd and 4th paragraphs).

Also as explained above, an olefinic feedstock with boiling points greater than 180°F approximately corresponds to a C_{7+} feedstock. The specification defines that a lube base oil has initial boiling points of at least 572°F (300°C) (approximately corresponding to C_{17}), and a typical lube base oil has an initial boiling point above 650°F (approximately corresponding to C_{20}). (Page 7, 6th paragraph and page 8, 3rd paragraph). Using the claimed olefinic feedstock, high quality lube oils are obtained by oligomerizing a minimum number of monomers. (page 8, 3rd paragraph). Applicants respectfully submit that since lube base stocks are C_{17+} to C_{20+} products, they can be produced from a C_{7+} feedstock in a single oligomerization step.

Accordingly, the hydrocarbons in the lube base oil range produced by the presently claimed process are produced in a single oligomerization step from the claimed olefinic feedstocks (i.e., a feedstock with a boiling point of greater than 180°F). A single oligomerization produces high quality hydrocarbons in the lube base oil range without excessive branching, which reduces the viscosity index. (page 8, 3rd paragraph).

It is respectfully submitted that the hydrocarbons in the lube base oil range produced by the presently claimed process are significantly different from the

products produced by the process of Huss. It is respectfully submitted that Huss does not disclose or suggest skeletal isomerization of the olefinic feedstock prior to oligomerization. In addition, as Huss discloses oligomerizing 1-olefins having from 3 to 20 carbon atoms, Applicants respectfully submit that making lube base stocks from the olefinic feedstock of Huss requires multiple oligomerization steps. Huss discloses oligomerizing 1-olefins having from 3 to 20 carbon atoms providing trimers and tetramers having viscosities in the lubricating oil range. Accordingly, Applicants respectfully submit that lube base oil products of Huss may have reduced viscosity indexes due to excessive branching. Therefore, Applicants respectfully submit that Huss does not disclose or suggest the presently claimed primarily single oligomerization of a feedstock with a boiling point of greater than 180°F. Since the process of Huss is significantly different from the presently claimed process, Applicants respectfully submit that Huss does not disclose or suggest the hydrocarbons in the lube base oil range produced by the presently claimed process.

As recited in new claim 22, the process of the presently claimed invention comprises inducing skeletal isomerization of an olefinic feedstock, with boiling point greater than 258°F, producing a skeletally isomerized olefinic feedstock. The skeletally isomerized olefinic feedstock is contacted with an oligomerization catalyst in a catalytic distillation unit to produce a product with a higher number average molecular weight than the olefinic feedstock. The product is separated in the catalytic distillation unit into a light by-product fraction and a heavy product fraction, wherein the heavy product fraction has an initial boiling point of at least 572°F and comprises hydrocarbons in the lube base stock range.

Skeletal isomerization of the olefinic feedstock assists in providing products with pour points in the desired range. Skeletal isomerization of the olefinic feedstock prior to oligomerization results in a higher yield of the lube base oil with a lower pour point. (page 14, 3rd and 4th paragraphs).

An olefinic feedstock with boiling points greater than 258°F approximately corresponds to a C_{8+} feedstock. The specification defines that a lube base oil has initial boiling points of at least 572°F (300°C) (approximately corresponding to C_{17}),

and a typical lube base oil has an initial boiling point above 650°F (approximately corresponding to C_{20}). (Page 7, 6th paragraph and page 8, 3rd paragraph). Using the claimed olefinic feedstock, high quality lube oils are obtained by oligomerizing a minimum number of monomers. (page 8, 3rd paragraph). Applicants respectfully submit that since lube base stocks are C_{17+} to C_{20+} products, they can be produced from a C_{8+} feedstock in a single oligomerization step.

Accordingly, in the processes of the presently claimed invention, lube base stocks are being produced in a single oligomerization step from the claimed olefinic feedstocks (i.e., a feedstock with a boiling point of greater than 258°F). A single oligomerization produces high quality lubricant products and avoids excessive branching in the lube oil, which reduces the viscosity index. (page 8, 3rd paragraph).

It is respectfully submitted that the presently claimed process for making a lube base stock comprising inducing skeletal isomerization of an olefinic feedstock, with boiling point greater than 258°F, producing a skeletally isomerized olefinic feedstock, and contacting the skeletally isomerized olefinic feedstock with an oligomerization catalyst in a catalytic distillation unit is significantly different from the process of Huss. It is respectfully submitted that Huss does not disclose or suggest skeletal isomerization of the olefinic feedstock prior to oligomerization. In addition, as Huss discloses oligomerizing 1-olefins having from 3 to 20 carbon atoms, Applicants respectfully submit that making lube base stocks from the olefinic feedstock of Huss requires multiple oligomerization steps. Accordingly, Huss discloses oligomerizing 1-olefins having from 3 to 20 carbon atoms providing trimers and tetramers having viscosities in the lubricating oil range. Accordingly, Applicants respectfully submit that lube base oil products of Huss may have reduced viscosity indexes due to excessive branching. Therefore, Applicants respectfully submit that Huss does not disclose or suggest the presently claimed primarily single oligomerization of a feedstock with a boiling point of greater than 258°F.

For at least the above reasons, the rejection under 35 U.S.C. §103(a) should be withdrawn. Such action is respectfully requested.

Claims 1 and 3-21 are also rejected under 35 U.S.C. § 103(a) as being unpatentable over Chang (U.S. Patent No. 4,678,645) in view of Huss. Applicants respectfully disagree with this rejection; therefore, this rejection is traversed.

Chang relates to a method and apparatus for producing distillate and/or lubes from a feed comprising C_3/C_4 hydrocarbons, such as LPG. The process of Chang uses two oligomerization zones, thus providing at least ***two*** oligomerizations of the light C_3/C_4 feed.

As explained above, Huss teaches oligomerizing 1-olefins having from 3 to 20 carbon atoms to provide oligomer fractions having viscosities with the lubricating oil range such as the trimer and tetramer of 1-decene. (Col. 8, lines 36-42).

It is respectfully submitted that even if there were some suggestion or motivation to combine Chang and Huss and a reasonable expectation of success, the documents when combined do not teach or suggest all the claim limitations of the presently claimed invention.

With regard to claims 1 and 21, even when combined, Huss and Chang do not disclose or suggest the presently claimed process for making a lube base stock comprising inducing skeletal isomerization of an olefinic feedstock, with boiling point greater than 180°F, producing a skeletally isomerized olefinic feedstock, and contacting the skeletally isomerized olefinic feedstock with an oligomerization catalyst in a catalytic distillation unit or hydrocarbons in the lube base oil range produced by that process.

It is respectfully submitted that neither Chang nor Huss discloses or suggests skeletal isomerization of the olefinic feedstock prior to oligomerization. In addition, as Chang discloses producing distillate and/or lubes from C_3/C_4 hydrocarbons, such as LPG, using two oligomerization zones and Huss discloses oligomerizing 1-olefins having from 3 to 20 carbon atoms, Applicants respectfully submit that making lube base stocks from the feedstocks of Chang and Huss require multiple oligomerization steps. Accordingly, Applicants respectfully submit that lube base oil products of Chang and Huss may have reduced viscosity indexes due to excessive branching. Therefore, Applicants respectfully submit that neither Chang nor Huss discloses or suggests the presently claimed primarily single oligomerization of a feedstock with a

boiling point of greater than 180°F. Since the process of neither Huss nor Chang disclose or suggest skeletal isomerization of the olefinic feedstock and both require multiple oligomerization steps to make lube base stocks from the light feeds, Applicants respectfully submit that even if combined, Chang and Huss do not teach or suggest the presently claimed process and hydrocarbon product resulting from that process.

With regard to claim 20, even when combined, Huss and Chang do not teach or suggest the presently claimed process for making a lube base stock by obtaining a diolefin-containing olefinic feedstock with boiling points within the range of from 258° to 650°F and including between 10% and 50% olefins; inducing skeletal isomerization of the diolefin-containing olefinic feedstock, producing a skeletally isomerized diolefin-containing olefinic feedstock; selectively hydrogenating the skeletally isomerized diolefin-containing olefinic feedstock to saturate at least a portion of any diolefins present while not saturating most of the mono-olefins present, producing a selectively hydrogenated skeletally isomerized diolefin-containing olefinic feedstock; and contacting the selectively hydrogenated skeletally isomerized diolefin-containing olefinic feedstock with an oligomerization catalyst in a catalytic distillation unit.

It is respectfully submitted that neither Chang nor Huss discloses or suggests skeletal isomerization of the olefinic feedstock prior to oligomerization. In addition, as Chang discloses producing distillate and/or lubes from C_3/C_4 hydrocarbons, such as LPG, using two oligomerization zones and Huss discloses oligomerizing 1-olefins having from 3 to 20 carbon atoms, Applicants respectfully submit that making lube base stocks from the feedstocks of Chang and Huss require multiple oligomerization steps. Accordingly, Applicants respectfully submit that lube base oil products of Chang and Huss may have reduced viscosity indexes due to excessive branching. Therefore, Applicants respectfully submit that neither Chang nor Huss discloses or suggests the presently claimed primarily single oligomerization of a diolefin-containing olefinic feedstock with boiling points within the range of from 258° to 650°F. Since the process of neither Huss nor Chang disclose or suggest skeletal

isomerization of the olefinic feedstock and both require multiple oligomerization steps to make lube base stocks from the light feeds, Applicants respectfully submit that even if combined, Chang and Huss do not teach or suggest the presently claimed process.

With regard to new claim 22, even when combined, Huss and Chang do not teach or suggest the presently claimed process for making a lube base stock comprising inducing skeletal isomerization of an olefinic feedstock, with boiling point greater than 258°F, producing a skeletally isomerized olefinic feedstock, and contacting the skeletally isomerized olefinic feedstock with an oligomerization catalyst in a catalytic distillation unit.

It is respectfully submitted that neither Chang nor Huss discloses or suggests skeletal isomerization of the olefinic feedstock prior to oligomerization. In addition, as Chang discloses producing distillate and/or lubes from C_3/C_4 hydrocarbons, such as LPG, using two oligomerization zones and Huss discloses oligomerizing 1-olefins having from 3 to 20 carbon atoms, Applicants respectfully submit that making lube base stocks from the feedstocks of Chang and Huss require multiple oligomerization steps. Accordingly, Applicants respectfully submit that lube base oil products of Chang and Huss may have reduced viscosity indexes due to excessive branching. Therefore, Applicants respectfully submit that neither Chang nor Huss discloses or suggests the presently claimed primarily single oligomerization of a feedstock with a boiling point of greater than 258°F. Since the process of neither Huss nor Chang disclose or suggest skeletal isomerization of the olefinic feedstock and both require multiple oligomerization steps to make lube base stocks from the light feeds, Applicants respectfully submit that even if combined, Chang and Huss do not disclose or suggest the presently claimed process and hydrocarbon product resulting from that process.

For at least the above reasons, the rejection under 35 U.S.C. §103(a) should be withdrawn. Such action is respectfully requested.

Claim 2 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Huss in view of Sweeney (U.S. Patent No. 4,527,004). Applicants respectfully disagree with this rejection; therefore, this rejection is traversed.

As explained above, Huss discloses oligomerizing 1-olefins having from 3 to 20 carbon atoms to provide oligomer fractions having viscosities with the lubricating oil range such as the trimer and tetramer of 1-decene. (Col. 8, lines 36-42).

Sweeney discloses a process for purifying predominantly straight chain olefins having from 5 to 50 carbon atoms. Sweeney teaches that the process may be utilized to purify C_5-C_{25} alpha-olefins obtained from a Fischer Tropsch process. Accordingly, Sweeney merely teaches a purification process for olefins, which may be utilized to purify Fischer Tropsch olefins.

Claim 2 is dependent upon claim 1 and thus recites further limitations. As explained above, Huss does not disclose or suggest the present claim 1. Sweeny discloses nothing that would supplement Huss in this regard. Therefore, it is respectfully submitted that even if there were some suggestion or motivation to combine Huss and Sweeney and a reasonable expectation of success, the documents when combined do not teach or suggest all the claim limitations of the present claim 2.

Even when combined, Huss and Sweeney do not disclose or suggest skeletal isomerization of the olefinic feedstock prior to oligomerization. In addition, Huss and Sweeny do not disclose or suggest the presently claimed primarily single oligomerization of an olefinic feedstock with boiling point greater than 180°F.

For at least the above reasons, the rejection under 35 U.S.C. §103(a) should be withdrawn. Such action is respectfully requested.

As set forth, withdrawal of the obviousness rejections is respectfully requested.

Conclusion

Without conceding the propriety of the rejections, claims 1-5, 12-14, and 16-21 have been amended, as provided above, to even more clearly recite and distinctly claim Applicants' invention and to pursue an early allowance. For the reasons noted

above, the art of record does not disclose or suggest the inventive concept of the presently claimed invention as defined by the claims.

In view of the foregoing amendments and remarks, reconsideration of the claims and allowance of the subject application is earnestly solicited. The Examiner is invited to contact the undersigned at the below-listed telephone number, if it is believed that prosecution of this application may be assisted thereby.

Respectfully submitted,

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Date: September 26, 2003